NON-PUBLIC?: N
ACCESSION #: 9003270377
LICENSEE EVENT REPORT (LER)

FACILITY NAME: DIABLO CANYON UNIT 1 PAGE: 1 OF 08

DOCKET NUMBER: 05000275

TITLE: MANUAL REACTOR TRIP DUE TO MAIN FEEDWATER PUMPS TRIPPING DUE TO
UNKNOWN CAUSE

EVENT DATE: 02/20/90 LER #: 90-002-20 REPORT DATE: 03/20/90

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: DONALD D. MALONE, TELEPHONE: (805) 595-4859
REGULATORY COMPLIANCE ENGINEER

COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE NPRDS:

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT:

On February 20, 1990, at 0530 PST, with Unit 1 operating at 100% power, plant operators initiated a manual reactor trip after both main feedwater pumps (MFPs) had tripped. Plant operators initiated actions per plant procedures and stabilized the unit in Mode 3 (Hot Standby) at 0600 PST.

A detailed investigation was performed using information from all event recorders and interviews with personnel involved. This investigation concluded that the immediate cause of the event was all main feedwater control valves tripping shut which caused both MFPs to trip on high discharge pressure. The investigation concluded that the most probable cause of the valves tripping closed was either a non-repeatable Solid State Protection System (SSPS) card failure or an inadvertent actuation

caused by Instrumentation and Controls (I&C) technicians working in the SSPS racks.

Immediate corrective actions included extensive testing and inspection of the SSPS to determine the root cause, replacement of the two suspect SSPS cards and a cautionary tailboard of I&C technicians regarding the potential hazards associated with SSPS testing.

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END OF ABSTRACT

I. Plant Conditions

Unit 1 was in Mode 1 (Power Operation) at approximately 100% power.

II. Description of Event

A. Event:

On February 20, at 0530 PST, a Manual Reactor Trip was initiated by licensed plant operators due to the loss of normal feedwater to the steam generators (SG)(SJ). A post trip review of the digital feedwater control system (DFWCS)(FC)(SJ) indicated that both main feedwater pumps (P)(SJ) tripped automatically in response to high feedwater header pressure.

All plant systems operated as required by design and the unit was stabilized in Mode 3 (Hot Standby) at 0600 PST, February 20, 1990.

The 4-hour non-emergency report required by 10 CFR 50.72 was made to the NRC on February 20, at 0735 PST.

Two Instrumentation and Controls (I&C) technicians were performing Surveillance Test Procedure (STP) I-16B, "Testing of Safety Injection Timer and Slave Relay K602," immediately prior to the event. In accordance with approved plant procedures they had placed the Solid State Protection System (SSPS)(JC) input test switch in inhibit and the output mode test switch in operate. They had just completed an initial digital voltmeter (DVM) reading and were moving the DVM to a location inside the SSPS rack when they heard a relay pick up in the protection set in which they were working (Train A). The technicians

proceeded to the adjacent control room to verify plant conditions and discovered a manual reactor trip had been initiated.

Plant operations personnel immediately reviewed the I&C work in progress and information from the General Electric Transient Analysis Recording System (GETARS), the plant computer system (CPU)(ID), the plant annunciator system (ANN)(IB), and the DFWCS output. No definitive equipment failure or personnel error could be immediately identified by reenactment of the testing in progress.

An Event Response Plan (ERP) was developed by plant personnel to investigate the event, identify the root cause, and review and document all immediate corrective actions required to verify the unit ready for resumption of power operation. (See section III.A Event Investigation and Analysis.)

B. Inoperable Structures, Components, or Systems that Contributed to the Event:

None.

C. Dates and Approximate Times for Major Occurrences:

1. February 20, 1990, 0530 PST: Event date. A Manual reactor trip was initiated.

2. February 20, 1990, 0530 PST: Discovery date. The event was immediately apparent due to alarms and indications received in the control room.

3. February 20, 1990, 0600 PST: Unit 1 was stabilized in Mode 3.

4. February 20, 1990, 0735 PST: A 10 CFR 50.72 4-hour non-emergency report was made.

D. Other Systems or Secondary Functions Affected:

None.

E. Method of Discovery:

The event was immediately apparent due to alarms and indications in the control room.

F. Operator Actions:

Plant operators confirmed both main feedwater pumps had tripped, could not be reset and initiated a manual reactor trip as a precautionary measure.

G. Safety System Responses:

1. The reactor trip breakers (BKR)(JC) opened.

2. The control rod drive mechanisms (DRIV)(AA) allowed the control rods to drop into the reactor.

3. The main turbine (TRB)(TA) tripped.

4. The motor driven auxiliary feedwater pumps (P)(BA) started automatically and delivered water to all steam generators as required.

III. Cause of the Event

A. Event Investigation and Analysis:

A multidisciplinary technical review group was established to investigate and analyze this event to identify the root cause. The results of this investigation are documented below:

The following is an evaluation of the potential causes of the MFP's tripping:

1) Safety Injection (SI) signal - No SI signal had been initiated.

2) Steam Generator HI Water Level - This signal was not

received.

3) Manual Trip - The feedwater pumps were not manually tripped.

4) Lube Oil Reservoir Low Oil Level - Low oil level would have actuated alarm Input L2105D, which was not actuated at the time of the trip.

5) Thrust Bearing Failure - Failure of the MFP's thrust bearing would have actuated alarm inputs Y2128D or Y2155D, which were not actuated at the time of the trip.

6) High Discharge Pressure - the first alarm received at the time of the trip was "Feedwater Header Pressure High" on the DFWCS annunciator. This verified that high discharge pressure was the cause of both MFPs tripping.

The following is an evaluation of the potential causes of a high pressure condition at the MFP outlet:

1) Closure of all Feedwater Isolation Motor Operated Valves - It was verified with operations personnel that the feedwater motor operated valves did not shut at the time of the trip. Also, the motor operated valves requires approximately forty to fifty seconds to move from open to close, which would have resulted in a more moderate feedwater header pressure transient.

2) Closure of all Feedwater Regulating and Bypass Valves - Based on the presence of "Feedwater Regulating and Bypass Valve Deviation" alarms first in on the DFWCS annunciator printout and "Feedwater Low Flow" alarms first in on the Main Annunciator prin
out, it was determined that the feedwater regulating and bypass valves were tripped closed.

Trip closure of the valves requires about three and a half seconds to five seconds.

A review of the feedwater header pressure recorded during

the event verified that closure of all feedwater regulating and bypass valves was the initiator of the loss of feedwater event. A failure of the DFWCS, which could cause all valves to modulate closed in fifteen to twenty seconds, or feedwater motor operated isolation valve closure, which requires forty to fifty seconds, was eliminated.

The following is an evaluation of the potential causes of all feedwater regulating and bypass valves tripping closed:

1) Blown fuse(s) In the power circuitry for either the Train A or Train B trip solenoids - No blown fuses were replaced prior to the valves being cycled approximately 1-1/2 hours following the trip. Since no fuses were replaced and the valves were successfully cycled, fuses were not blown.

2) Loss of power to the Vital 125 VDC bus which feeds the trip solenoids - Analysis of the Main Annunciator printout showed no indication that the vital bus lost power. Had power been lost to that bus, numerous other alarms would have been received.

3) Activation of SSPS slave relay K601 - K601 actuation occurs when the SSPS initiates a Safety Injection (SI) signal. An SI did not occur. Also, K601 is a latching type relay and was not latched following the event. Unlatching K601 requires the SI reset button to be depressed, which was verified not to have been done.

4) Activation of SSPS slave relay K636 - K636 actuation occurs when a Low Tavg signal is received in coincidence with opening of the reactor trip breakers. The same master relay that drives K636 also drives K637, which actuates the "Feedwater Isolation" annunciator. As this annunciator was not actuated until after the trip when Tavg dropped below 554 degrees F, and tested satisfactory after the event it was determined that actuation of K636 was not the cause of feedwater regulating and bypass valve closure.

5) Activation of SSPS slave relay K620 - As all other reasons for the feedwater regulating and bypass valves tripping closed have been eliminated, it was determined that the cause of closure was inadvertent actuation of K620.

Slave relay K620 is designed to be actuated when either of the two following events occurs:

1) Manual Safety Injection, or 2) 2/3 High Water Level signals in 1/4 Steam Generators

As neither of these conditions existed at the time of the trip, K620 in the opposite protection set (Train B) would not have been actuated. Also, due to the SSPS Train A input test switch in inhibit, no spurious actuation from the process control racks was possible. Analysis of SSPS logic determined that the only failures which would actuate K620 are failure of Universal Logic Card A213 or Safeguards Output Card A517.

Just prior to the trip, I&C personnel were performing routine surveillance testing, STP I-16B, in the Unit 1 SSPS. Procedure step 6.2.2 had just been completed, test leads removed from the SSPS, and the setup for step 6.2.3 was being made. This step requires the monitoring of safety injection slave relay K602 reset coil voltage while performing procedural substeps. For ease of observation, the I&C technicians placed a voltmeter in a vacant section of the card cage in the SSPS logic cabinet directly above the Universal Logic and Safeguards Output cards. During interviews, the I&C technicians reported that as the voltmeter was being placed in the card bay, they audibly observed a relay actuation. They immediately went to the control room and observed that operations personnel had manually tripped the reactor due to loss of both MFP's.

An inspection of the SSPS Logic Cabinets and surrounding areas was then conducted. During the course of this inspection, small bits of metal debris were noted in the bottom of the logic cabinet directly below the card cage where the voltmeter had been placed. Additional debris was noted on the floor outside the cabinet. The area in and around the SSPS Logic Cabinets were then vacuumed to remove the debris.

An evaluation of the potential shorting of lands, components, or circuits on the Universal Logic and Safeguards Output cards with the metallic debris described above was conducted. The evaluation determined that if the debris described above was the initiating agent it had to land on a limited number of

sensitive connections of the vertically installed card, remain in place for more than twenty four seconds and then fall free to the bottom of the card cage. Although possible, this scenario is considered a low probability event.

As part of the investigation to determine the cause of actuation of relay K620, the SSPS was removed from service and a modified STP I-16B was performed in an attempt to recreate the conditions existing at the time of the trip. I&C personnel were unable to recreate the K620 actuation

during this testing. Following this test STP M-16P2. SSPS Slave Relay Testing," was performed and no discrepancies were found. The SSPS was then removed from service and the suspect cards (A213 and A517) were replaced with tested spares.

The suspect cards (A213 and A517) were then tested in the Training Facility SSPS cabinets. The cards were heat cycled several times between 60 and 120 degrees F, mechanically agitated, and subjected to logic testing. No component or logic problems were found with these cards during testing. It was confirmed that an electrical short between two adjacent integrated circuit pins on the A213 card could produce an inadvertent actuation of the output relay K620. However, the probability of the exact sequence of events that would allow a piece of debris to cause the actuation and later in time migrate to below the card cage is considered low.

Therefore, the exact cause of energizing slave relay K620 is unknown.

B. Immediate Cause:

The immediate cause of this event was the inadvertent trip closure of the feedwater control valves resulting in both main feedwater pumps tripping on high feedwater header pressure.

C. Root Cause:

The exact root cause of this event is unknown. However, it has been concluded that the most probable cause of the tripping of the feedwater control valves was either a non-repeatable SSPS

card failure or inadvertent actuation by I&C technicians working in the SSPS racks.

IV. Analysis of the Event

A. Safety Analysis:

Inadvertent loss of all main feedwater flow is a Condition II event as described in the Final Safety Analysis Report (FSAR) Update. This type of event has been analyzed in FSAR Section 15.2.8, "Loss of Normal Feedwater." The manual reactor trip and automatic start of the auxiliary feedwater pumps ensured that an adequate supply of water was provided to the steam generators to provide for the cooldown of the reactor per design. Thus, the health and safety of the public were not adversely effected, and there were no adverse consequences or safety implications resulting from this event.

V. Corrective Actions

A. Immediate Corrective Actions:

Due to the unknown cause of the feedwater pump trip plant management initiated an Event Response Plan to investigate all possible causes.

As a precautionary measure SSPS cards A213 and A517 were replaced and the train retested in accordance with plant procedures. Also the I&C technicians were tailboarded regarding the potential hazards of test equipment use during SSPS testing.

B. Corrective Actions to Prevent Recurrence:

There are no further corrective actions identified.

VI. Additional Information

A. Failed Components:

No failed components could be verified. However as a precautionary measure the Westinghouse SSPS cards A213 (a

universal logic card) and A517 (a safeguards output card) were replaced.

B. Previous LERs on Similar Problems:

None.

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James D. Shiffer
Senior Vice President and
General Manager
Nuclear Power Generation

March 20, 1990

PG&E Letter No. DCL-90-076

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Re: Docket No. 50-275, OL-DPR-80
Diablo Canyon Unit 1
Licensee Event Report 1-90-002-00
Manual Reactor Trip due to Main Feedwater Pumps Tripping
Due to Unknown Cause

Gentlemen:

Pursuant to 10 CFR 50.73(a)(2)(iv), PG&E is submitting the enclosed Licensee Event Report (LER) regarding a manual reactor trip due to main feedwater pumps tripping due to unknown cause.

This event has in no way affected the public's health and safety.

Kindly acknowledge receipt of this material on the enclosed copy of this letter and return it in the enclosed addressed envelope.

Sincerely,

J.D. Shiffer

cc: A.P. Hodgdon
J.B. Martin
M.M. Mendonca
P.P. Narbut
H. Rood
CPUC
Diablo Distribution
INPO

Enclosure

DC1-90-TI-N0007

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